Professional Paper 1-69
January 1969

Use of Job and Task Analysis in Training

Presentations at
Headquarters
U.S. Continental Army Command
Fort Monroe, Virginia October 1968

HumRRO

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE

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Prefatory Note

This paper records the presentation made by members of the Human Resources Research Office to the staff of Headquarters, U.S. Continental Army Command, Fort Monroe, Va., in October 1968, on the subject of using job and task analysis in training. The presentation consisted of a description of the ways of performing a job analysis and selecting training tasks that have been designed for HumRRO Work Units CAMBCOM, MBT, STOCK, and UPGRADE.

The presentation was the first of a series of briefings on education and training research and development programs of the U.S. Army Behavioral Science Research Laboratory (BESRL), the Center for Research in Social Systems (CRESS), and HumRRO. It was sponsored by the Office of the Chief of Staff for Individual Training, USCONARC. The series of briefings has been planned to inform USCONARC of work being done in training and related human factors research.

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Opening Remarks

Major General George G. O'Connor
Deputy Chief of Staff for Individual Training

This morning's presentation, sponsored by the Office of the Deputy Chief of Staff for Individual Training (ODCSIT), is the first of a series of briefings covering the spectrum of the training research and development programs of the U.S. Army Behavioral Science Research Laboratory (BESRL), the Human Resources Research Office (HumRRO), and the Center for Research in Social Systems (CRESS).

Today's presentation, "Use of Job and Task Analysis in Training," will be made by representatives from HumRRO. HumRRO, which is one of the largest organizations of its kind in the United States, is the principal source of training research and development for the U.S. Army. Today's briefers will describe job and task analysis and its role in curriculum engineering. Specific examples of the application of job and task analysis in different training situations will be covered. The presentations will be concluded with a statement of training implications by the ODCSIT Education Advisor.

We are very fortunate to have with us this morning, Dr. Meredith P. Crawford, the Director of HumRRO since it was established in 1951. An eminent psychologist, Dr. Crawford previously served as Professor of Psychology and, later, Dean of the College of Arts and Sciences at Vanderbilt University. He holds a B.A. degree from that institution and M.A. and Ph.D. degrees from Columbia University. He has been awarded the Distinguished Civilian Service Medal by the Secretary of the Army for his efforts in carrying out an integrated program of human resources research for the Department of the Army. Dr. Crawford is a veteran of World War II and is currently affiliated with numerous professional groups.

Gentlemen, it is my pleasure to introduce to you at this time, Dr. Crawford, who will "kick off" the presentations.

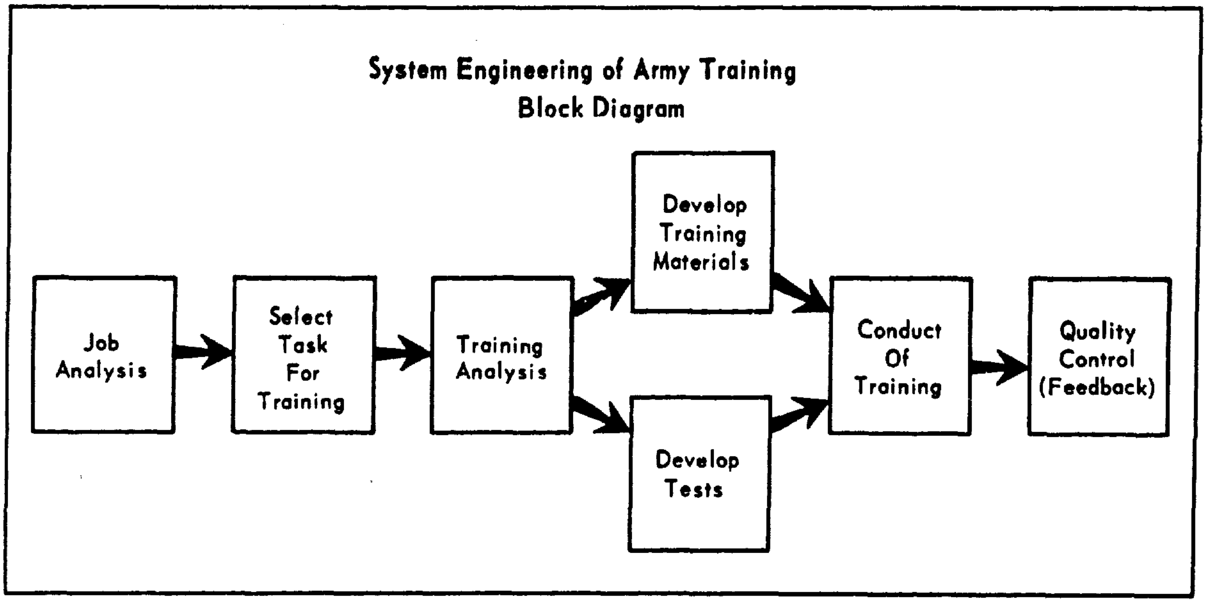
Introduction

Dr. Meredith P. Crawford
Director, HumRRO

I am very pleased to introduce this first in a series of briefings on research and development on training and related human factors matters. All four of the presentations this morning will be made by members of HumRRO. In future programs, I believe that members of BESRL and CRESS, as well as HumRRO, will participate in programs featuring work of one of these agencies or an appropriate combination from two or all three.

In these briefings, our primary purpose is to inform you of our work in selected areas of interest to your headquarters. While many of you will see implications for action in these briefings, they will not contain recommendations. Each program will bring together Work Units related to one general topic, so that you may see similarities and differences among the various efforts. We hope you will be able to get the flavor of the research approaches used.

This morning the topic is *job analysis*. It is the first step and part of the second in the kind of systems engineering of training which is now prescribed in USCONARC Regulation 300-100-1, *Systems Engineering of Training*. Slide 1 shows the several steps in that process. It is apparent that, to do the engineering of training properly, the job must



Slide 1

be analyzed in appropriate detail before the other steps can be taken. They really all depend on doing the job analysis well.

In the presentations this morning you will hear four different yet related ways of doing a job analysis and the associated selection of tasks for training. You will observe that it is all detailed work, is often slow, and at times may be tedious. You may be surprised at the number of different elements into which a job may be dissected in careful analysis—but the dissection must be done to build an adequate training program which fits the officer or soldier for all aspects of the job.

We could arrange our presentation this morning in several orders. We have chosen to use an order which reflects the state of completion or degree of progress on each Work Unit represented, those two farthest along coming first, and the two newer efforts later. We could arrange them in other orders. For example, the presentation by Dr. Haggard, which comes second, concerns job analysis of jobs for a system still under development, while the other three concern jobs which now exist. Again, we could have arranged them in an order to reflect the kind of job. Two presentations, Dr. Haggard's and Dr. Prophet's, which comes fourth, concern jobs that are tied to particular equipment—the tank and the helicopter. The other two, by Dr. McKnight and Mr. Powers, are on jobs that are not tied to specific weapons—the supplyman and the battalion staff and battalion commander.

I suggest these other possible orders of presentation to you to call attention to different relationships between the four statements you will hear.

Work Unit STOCK
Development of Training Management Procedures for Heterogeneous Ability Groups

Dr. A. James McKnight
Senior Staff Scientist, HumRRO Division No. 1 (System Operations)

I shall describe a program of task analysis used in developing a training program for the Supplyman course, MOS 76A10, taught by the U.S. Army Quartermaster School (USAQMS). The program was conducted jointly by HumRRO and USAQMS, and when I use the term "we" during the course of this briefing, it will refer to personnel of both organizations. The analytic process that we used was, I'm sure, highly similar to that employed by others who will address you today and to the process prescribed by USCONARC Regulation 350-100-1. However, task analysis has typically been treated heretofore as a means of generating the informational input to the development of training content. It was our desire to use the results of task analysis more dynamically in the *control* of training content, and we introduced a number of innovations intended to enhance the value of the analytic process to this end.

The development of a new Supplyman course was undertaken by USAQMS as a part of Project 100,000. The purpose was to adapt training objectives, content, and method of instruction to a student input containing a significant portion of personnel in the lower reaches of mental Category IV—the "New Standards" personnel inducted into the Army under Project 100,000. HumRRO was asked by USAQMS to assist in this effort by establishing a set of duty-oriented training objectives and performance standards that would guide both the development and evaluation of the training program. The analytic program began a little over a year ago and concluded last February.

The systematic development of training objectives and performance standards is a necessary step in the construction part of any course. It is, however, of particular importance in a program that is to accept personnel of marginal intelligence. Take training objectives first. We know that as one descends the intellectual ladder, the need for highly practical, "hands-on" instruction becomes increasingly important. Whereas a bright student may be expected to apply principles and theory to the solution of problems as they arise in the field, the less apt student must be given more explicit instruction in the specific procedures involved. Obviously, highly practical instruction cannot be provided unless the tasks to be performed have been anticipated and analyzed in advance. It is these tasks-to-be-performed that constitute the objectives of training.

Performance standards also assume greater importance where marginal personnel are involved. We can assume with reasonable certainty that

any bright individual is capable of making some contribution to the unit to which he is assigned; the same cannot be said of Project 100,000 inductees, some of whom are probably incapable of providing any real service to a supply operation. To prevent such individuals from becoming a burden to their units, it is necessary to establish some set of minimal performance standards.

How did we proceed? The first step was to assemble an inventory of the supply tasks to be performed by the Supplyman. From this inventory those tasks which were to become the objectives of training would later be selected. To make sure that our initial inventory of tasks was a comprehensive one, we prepared an exhaustive list of all the operations that make up a supply system, including requisitioning, issuing, and turn-in. This listing was repeated for each level of supply in which the Supplyman might be engaged, that is, unit, organization, direct support, and depot.

For each supply operation we identified the specific tasks that would be required to carry it out effectively. Knowing that supply tasks differ somewhat with the type of commodity involved, we identified tasks separately for each type of commodity handled, for example, for petroleum, repair parts, and medical supplies. We found it helpful, as have others, to construct a matrix down the side of which were listed the supply operations, and across the top of which were listed the various commodity areas (Slide 1). In each *cell*, that is, each intersection of a supply operation and commodity, we listed the tasks required to carry out that operation. The use of a matrix helped us to make sure that all tasks were accounted for.

Task Identification Matrix

Action	**Commodity**					
	Parts	Clothing	Ammunition			
Request						
Turn-In						

Slide 1

The next step was to analyze each task into its component steps. At first glance, it might seem more reasonable to select tasks for training before going to the trouble of analyzing them. The problem is that you really have to know what a task consists of before you can make an intelligent decision as to whether to include all or part of it in training. A task that on the surface seems quite simple and readily taught may, upon closer inspection, prove so complex that it will be wiser to defer any instruction until the individual has acquired a degree of field experience.

In analyzing tasks we were careful to cover the entire task from beginning to end. For example, the task of requisitioning a repair part did not commence with filling out a supply form. Rather, it began when the Supplyman was asked for the part and included such preliminary activities as ascertaining whether the part was authorized, determining the priority to be assigned to the requisition, and obtaining stock numbers. Nor did completion of the form terminate the task; the form had to be signed and distributed and the transaction had to be posted.

Why were we so fussy about tracing activities back to their origin and out to their conclusion? First, it helped us make sure that everything was accounted for. Had we been willing to treat the completion of a supply form as a separate task—as was generally done in the past—we might well have overlooked the need to determine in advance whether the item was authorized.

A second major reason for treating tasks exhaustively is to assure that the context of every activity was well understood. For example, one task our supply specialists had identified was that of "maintaining the Document Register." The Document Register is a form upon which various supply transactions are recorded. When we first considered this task, it seemed that the responsibility for it was something that appropriately belonged to the Supply Clerk rather than his helper, the Supplyman. Yet as we examined the context into which this supposed task fit, we discovered that the document register is not really "maintained" at all. Rather, it is a form to which supply personnel have recourse in carrying out a variety of supply procedures. It did not seem feasible to trouble the Supply Clerk every time a transaction was posted. Therefore, the task of "maintaining the Document Register" evaporated and recourse to the Register became a step in the performance of other tasks such as requesting supplies or receiving shipments.

So much for the scope of the task analysis; now to the depth. Each task was analyzed down to the level of the individual task element. An element is a statement of the specific behavior involved in individual steps of a task, including the action required, the objects toward which the action is directed, those cues which guide or terminate the action, and any other relevant conditions. In the column labeled "Task Description" in Slide 2 is an example of one segment in the analysis of the task of requesting organizational clothing and equipment. One subtask of this task, as you can see, is filling out DA Form 3161. The first major step of this subtask is identifying the item being requested.

IDENTIFICATION	TASK DESCRIPTION	ENABLING KNOWLEDGE	SKILL	PERF. STAND.	REF.	COURSE LOCAT.
12200	REQUEST ORGANIZATIONAL CLOTHING AND EQUIPMENT				AR 735-5	B3
12210	IF AT UNIT, REQUEST FROM ORGANIZATION BY THE MOST EXPEDITIOUS MEANS			.80	" P.42	" P.11
12220	IF AT ORGANIZATION, SELECT THE APPROPRIATE FORM	THE PURPOSE OF DA FORMS 3161 & 2765-1		.80	" P.43	" P.22
12230	IF MORE THAN TEN LINE ITEMS, PREPARE FOUR COPIES OF DA FORM 3161					
12231	TYPE NAME OF SUPPORTING UNIT IN BLOCK 1		MOTOR	.90	" P.44	" "
	. . .					
12234	TYPE IN BLOCK 4d THE NAME OF THE PUBLICATION THAT AUTHORIZES THE ITEMS	THE TYPE OF AUTHORIZATION DOCUMENT (TOE) THAT AUTHORIZES ORGANIZATIONAL CLOTHING AND EQUIPMENT	MOTOR	.70	" "	" P.23

Slide 2

At the most detailed level we see the various task elements listed: "Type name of supporting unit in Block 1," down to "Type in Block 4d the name of the publication that authorizes the items." Note that at the element level the behavior is clearly described.

Once all of the tasks had been described in this manner, the task descriptions were reviewed by USAQMS and those tasks to be covered by school training were selected. Since the selection process was pretty much a USAQMS affair, I'll forego a discussion of the considerations which guided the process. Suffice it to say that the product of their deliberations, the Supplyman task list, represented a set of duty-oriented training objectives that served to guide both the conduct and eventual evaluation of the course.

The purpose of analyzing the Supplyman's tasks was not simply, or even primarily, to aid in the selection of training objectives. Rather, it was to aid in the determination of training content by revealing the skills and knowledges that must be developed through the training process. It is only when a task is reduced to its elements that we are able to see the specific knowledges, the specific items of information, needed to carry out the task. These knowledges we listed in column three of Slide 2 alongside the task element to which they corresponded. When the knowledge consisted of nothing more than knowing the elements of the task, we did not repeat this procedural information under the

knowledge column. Rather, we used that column to record facts, principles, concepts, relationships, and other types of information that the individual needed to enable him to carry out the series of actions. You see two examples listed. Other examples of "enabling knowledges" in the Supplyman analysis are priority codes, formulas for determining authorized allowances, and stock location codes. In treating enabling knowledges we were careful to confine ourselves to the specific information required in the task and not merely reference a general subject area. By adopting this restrictive approach, we succeeded in eliminating sizable portions of traditional supply subject matter that did not prove relevant to any task. For example, we found that multiplication and division of fractions, a subject that had consumed considerable training time in the past, was not required of the Supplyman.

In addition to knowledges, we made note of any tasks that required development of perceptual, motor, problem-solving, and decision-making skills (column four of Slide 2). The purpose of bringing these skill requirements to the surface was to alert the instructor to tasks that would be likely to require repeated practice for their mastery.

The USCONARC Systems Engineering Regulation (350-100-1) requires that performance standards be established for each task. Standards may be expressed in terms of *accuracy*—the maximum permissible deviation around the correct value, *time*—the maximum acceptable time from start to finish, or *reliability*—the minimum acceptable likelihood of a correct performance, that is, of a performance within specified accuracy and time limits. Since few supply actions are time critical, and there is no range of acceptable performance (it's either right or wrong), the only meaningful performance standard for the Supplyman appeared to be reliability.

Initially, we attempted to apply performance standards to tasks as a whole, for example, requiring that a form be completed with no more than three errors. However, one overall performance standard for a task did not appear realistic because it treated all errors as essentially alike. It would, for example, make no distinction between an incorrect Federal Stock Number and a misspelled name. We felt it was therefore necessary to assign performance standards to each individual task element. This was done in two phases (Slide 3). First, we had our field-experienced supply specialists sort task elements into four categories: (a) those in which an error could produce severe delays or result in incorrect supplies being received; (b) those in which errors would produce minor delays or result in incorrect quantities being received; (c) those in which errors were likely to be detected, but which could produce delays or incorrect shipments if they were not; and (d) those that would have no effect upon the supply action but would merely reflect sloppy work.

Once the elements had been classified, representatives of the Quartermaster School and the Quartermaster Combat Developments Agency reviewed them and assigned reliability standards to each category. Task elements in the first category were assigned a standard of .90, meaning that 90% of elements in this category had to be performed correctly before the student could be considered qualified. The

Course Performance Standards

Type of Error	Standard
Would produce severe delay or incorrect supplies	.90
Would produce minor delay or incorrect quantity	.80
Detectable errors	.70
Sloppy work	.50

Slide 3

standard for the second category was .80, for the third category .70, and for the fourth category .50 (column five of Slide 2). Setting standards in this manner allowed the instructors then to identify which elements of which tasks should receive major emphasis. Equally important, the standards provided a quality control measure for evaluating personnel. Students taking an end-of-course performance test were expected to get 90% of category one elements correct, 80% of category two elements correct, and so on.

I said at the outset that we were anxious to have the task analysis play a more dynamic role in the development of course content than merely providing an information input. We introduced three innovations toward that end. One of these was to identify for each task element the regulatory document from which the requirement for that element was obtained (column six of Slide 2). These documents included Army regulations, technical manuals, and tables of allowances. In other MOSs they might also include field manuals, pamphlets, circulars, or bulletins. In addition to the documentary source of task elements, we also indicated the dispensation of each task element within the course by listing alongside the element the page and number of the lesson plan in which it was covered (column seven of Slide 2). This listing of reference sources and course locations of task elements was intended to allow rapid and economical updating of course content as changes occurred in published Army doctrine.

It is of little value to apply a systematic process for developing training content if there is no mechanism to assure that the process has been properly used. We therefore set up a procedure by which course content was cross-checked against the task description which served as the list of training objectives. First, we checked to see if every task element was included in the course. The list of course locations helped us here. Second, we checked to see if each item of training content was related to some task element. This process of comparing the task description with training content was called a "discrepancy analysis." The discrepancies revealed by this analysis were listed in a separate report and submitted to the Quartermaster School. Based upon the

decision of the School, either the lesson plans or the task description which served as a list of training objectives was revised.

Let me conclude this briefing with the description of the final innovative step undertaken in the Supplyman course revision, the use of a computer for preparation of task analytic reports. Throughout the development of the Supplyman course, repeated revisions were required in the task descriptions and the other information that I've described. Tasks and task elements were added to or dropped from the list as decisions on training objectives were reached and re-reached. Tasks were combined or divided up and elements were shifted from one task to another. Changes in task descriptions produced changes in knowledges, skills, source references, course locations, and performance standards. To prepare new reports manually as significant changes occurred would have required the services of several full-time typists. However, by entering all task analytic information in a computer and having the computer print out the reports, we could accommodate changes rapidly and economically and provide an up-to-date report at any time. I have with me a copy of the complete computer-printed task description of the Supplyman course. We're still making changes in our computer programs to improve the report format from the viewpoint of readability.

While the computer served primarily as an automatic, high-speed typewriter, it was also valuable in helping us to correlate various data items, as for example all of the tasks and lesson plans associated with a particular reference document. The computer also allowed us to make various statistical analyses such as determining the number of tasks that required use of a particular supply form.

The fundamental role played by task analysis in the Supplyman course was similar to that played by task analysis in other training applications. The results of the task analysis provided a performance specification as well as a principal information input into the development of training content. The novel features of our approach were intended to enhance the value of task analysis in this respect. To recapitulate, these features were (Slide 4):

Supplyman Task Analysis Innovations

- Source — Course Location Correlation
- Discrepancy Analysis
- Computer Processing
  - Updating
  - Data Correlation
  - Statistical Analysis

Slide 4

(1) The pulling together of various types of task-related information such as the documentary source of task requirements and the location within the course where the requirement is fulfilled. This consolidation of information is extremely useful in assuring that training is kept up to date as changes occur in such areas as Army doctrine, field requirements, and equipment provided.

(2) The conduct of a discrepancy analysis—a cross-checking of tasks and training content—to assure that performance specifications are being fulfilled by the course. Without such a follow-up procedure, task analytic reports have a way of being put on the shelf to gather dust.

(3) The use of computers for rapid and economical processing of task data, including (a) updating of task analytic reports, (b) correlation of data items (e.g., a list of tasks associated with a particular reference source), and (c) performing statistical analyses (e.g., totaling frequencies or time standards).

Some day the development of qualified personnel will be subject to the same systematic processes that guide the development of equipment. I feel that what I have described is a modest step in that direction.

Work Unit MBT
Training Guidelines for the US/FRG Main Battle Tank

Dr. Donald F. Haggard
Director of Research, HumRRO Division No. 2 (Armor)

Work Unit MBT is sponsored by the U.S. Army Materiel Command (Program Manager, US/FRG MBT). The purpose of the Work Unit is to provide the concepts for training methods and materials that will be needed by the people responsible for developing training programs for the MBT-70 (Slide 1). Since our approach involves more than just training research, I would like to preface the specific progress report with some general comments related to our objectives in this study.

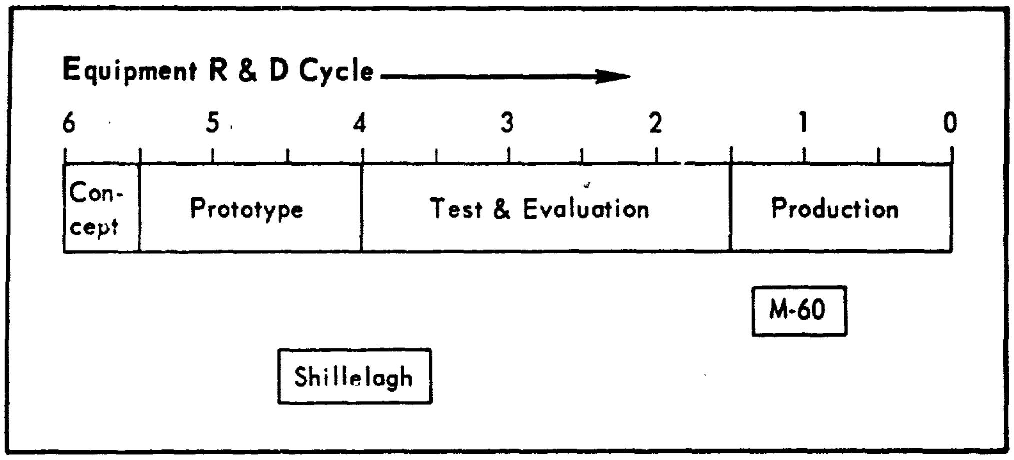
Work Unit MBT-70 Objective

Provide:	Training Methods Training Materials
To:	Training Program Developers
For:	Operator Training User Maintenance Training

Slide 1

During the past several years, Division 2 (Armor) has been requested to provide some human factors input for each phase of the equipment R&D cycle. These requests have resulted mainly from our activities in determining training requirements for new weapon systems. In this paper, when I refer to "training requirements" I will mean content and standards rather than the usual training facility and administration requirements. While these training requirements studies have seldom been a programmed part of the R&D cycle, they have given us experience in each phase of that cycle and, specifically, with the human factors considerations for training that are necessary to each phase.

For example, during the development of the M-60 tank we were asked by the U.S. Armor School to perform a human factors analysis for the Troop Test which was being conducted during the first production run (Slide 2). The results of this analysis indicated over 150 deficiencies; 64 were so serious that they led to an immediate re-engineering and retrofit. Obviously, these changes were made at a much higher cost than



Slide 2

if the deficiencies had been detected earlier in development. However, this study also emphasized the fact that training information was not being provided to the training establishment until the equipment was virtually in production. Even then very little training-pertinent information was available.

This latter deficiency was further emphasized when USCONARC asked us to investigate possible changes in training requirements that might be imposed by adoption of the Shillelagh weapon system. While this request was made earlier in the cycle than for the M-60, the equipment was already in prototype and no training information had been developed. Obviously, such things as the training support plans, training device requirements, and MOS statements that were already submitted and approved had had to be based on pure conjecture.

These two major experiences, and a number of similar activities on smaller items of equipment, showed the need for more closely paralleling the hardware and the human R&D cycles. To be effective, training considerations must be included during each phase of the hardware cycle. Not only is this necessary to the timely development of training programs, but it is also necessary to insure that the results of these considerations are fed back into succeeding phases of the hardware cycle at the earliest possible time, thereby minimizing both the training support requirements imposed by the system and the cost of equipment changes. Based on this experience then, we proposed an integrated man-machine development cycle. This proposal, which the former Director of Research of Division 2 presented to USCONARC, has been the basis for our planning for MBT. Incidentally, it was also the guideline for the USCONARC presentation to General Haynes on Training Device Requirements Associated with New Combat Vehicles and for the draft 71 series of Army regulations concerning the Training Device Program for Training Support.

The other briefings today are concerned with generating task or training information from jobs and training programs already in being.

The concept we are proposing is intended to integrate the requirements for the Systems Engineering of Training into the normal hardware R&D cycle. Its purpose is to provide a well-planned and tested training program concurrent with the requirement to initiate training.

Briefly, the concept interfaces the equipment and human analyses along a common time line. At each point in the equipment cycle it specifies what types of information will be obtained and what the information will be used for—first in hardware and then in training development.

During the early concept phase (Slide 3), human capability analyses will indicate the kinds of equipment and tactics that can be supported, and rather gross trainability analyses will indicate the general character of the training requirements. As we progress into the Design Concept Phase, these estimates can be relatively quickly firmed up and we can specify the functions that can best be provided by men or by equipment.

As development reaches the stage of mock-up and prototype fabrication (Slide 4), we can develop the job descriptions and the skill and knowledge requirements to provide a basis for determining equipment configuration and location, and for planning and coordinating test and evaluation. For training, we can then determine the performance standards that will be required of the man-equipment system and then separately for the man in that system.

From this information we can develop the training objectives. We might note that this information would now be available at the time it is required for MOS and New Equipment Training considerations. Additional basic training information can now be made available in time to plan, develop, and test the resident training program and to implement that and other programs coincident with the requirement to initiate training (Slide 5).

Based on this approach, we originally proposed a human factors monitoring program for coordinating the activities of the MBT-70 developer with the activities of the various military agencies that were concerned with portions of this total human factors picture. The plan was presented to General Dolvin in November 1963. For a number of reasons the plan was not implemented, but it did help direct some of our Technical Advisory Service activities on the MBT program (Slide 6) which led to the approach we did take when we were asked into the program some three years later.

During this interim HumRRO was able to assist USCDC in the study of human capability and trainability factors involved in the proposed tactical and equipment concepts. Based on these studies Division 2 drafted the initial estimates of human performance requirements and training and training device considerations which were included in the QMR. Related to this, we later continued the concept studies for USAMC and helped coordinate the Human Factors Study Program which is now in process, scheduling time requirements for analyses and stipulating agency responsibilities. This program was the basis for the US/FRG meetings that resulted in a joint human factors study

Concept Phases

Analyses –
1. Human Capability
2. Trainability

Hardware Results –
1. Equipment – Tactical Feasibility
2. Man-Machine Function Allocation

Training Results –
1. General Training Requirements

Slide 3

Prototype Phases

Analyses –
1. Job Descriptions
2. Skill and Knowledge

Hardware Results –
1. Equipment Configuration
2. Test and Evaluation Plans

Training Results –
1. Performance Standards
2. Training Objectives

Slide 4

Test Phases

Analyses –
1. Training Methods
2. Training Support
3. Human Performance Parameters

Hardware Results –
1. System Performance Parameters
2. Maintenance and Operation SOP
3. Equipment Support Requirements

Training Results –
1. Resident Training Program
2. OJT and Proficiency Maintenance

Slide 5

MBT Technical Advisory Service 1963–1966

1. QMR Human Factors Estimates (USACDC)
2. Human Factors Study Program (USAMC)
3. Preliminary Training Concept (USCONARC)

Slide 6

program and information. Finally, Division 2 developed a preliminary training concept for the 1970s that included:

1. The need for integrating training programs wherever possible, so that excessive training time does not accumulate from a series of separate training programs on related items of equipment.

2. The growing requirement for simulation of target, terrain, and environmental conditions in training, due to the new extended-range weapons and nuclear battlefield capabilities and tactics. This concept

has since provided the basis for Armor Center planning for the 1970 time frame.

Thus by July of 1966, when the Program Manager asked HumRRO into the program, we at Division 2 had established a general approach to the problem and were particularly cognizant of the fact that, while development was already in the prototype phase, no specific training data had been determined. Our proposed Work Unit then reflected these conditions. Normally the job requirements analyses that are necessary for training development should be done by USAMC. However, the work had not been initiated, so the Program Manager requested that it be included in our Work Unit. Since we were interested in determining the applicability of the complete approach, and the points at which further methodological work was necessary, we extended our plan to include this area.

Work Unit MBT thus consists of three separate but overlapping stages (Slides 7, 8, 9, & 10). The first stage provides the job descriptions—that is, the skill and knowledge requirements, functional procedures, and performance standards. This stage has been completed for crew operation and maintenance and is partially completed for user maintenance, although completion of the maintenance requirements has been temporarily suspended pending the outcome of the current hardware discussions. For the second stage, training objectives are being written and the methods and materials for meeting these objectives will be specified or developed. We have completed a few studies in this area but are now mainly initiating this work. During the final stage HumRRO will assist the Armor School and Armor Center, and some other training commanders, in incorporating these methods and materials into a prototype training program, administering the program to a selected sample of trainees, and evaluating its effectiveness during the Service and Troop Tests. For this stage Division 2 has written a training test plan that was incorporated into the Plan of Test for Service Testing the MBT, and have been coordinating the requirements of this test with the other agencies that will be involved.

Let me now review in a little more detail what has been accomplished to date on the crew analyses, with the understanding that a similar effort is under way for user maintenance.

For the description of the job, we initially developed equipment-oriented task descriptions for each of the MBT crew members (Hand-Out 1: Preliminary Crew and Maintenance—five reports).[1] These descriptions were based on the available technical descriptions and drawings of the equipment, mock-up reviews, and interviews with Army and industrial development personnel. The descriptions were then checked for accuracy and completeness through the Program Manager's Office. At the same time, similar descriptions were completed for the M60A1E2 and the M551 (Hand-Out 2: A1E2 and 551—three reports). This material has been used by General Motors and the U.S. Army Human Engineering Laboratory to plan and conduct human engineering studies for the Engineering

[1]The titles of the reports in the handouts are collected at the end of this briefing on MBT.

Research Approach

Stage I. Job Descriptions
- A. Task Descriptions
  - 1. Human Engineering Studies
  - 2. Training Device Concept Study
- B. Functional Procedures
  - 1. Human Performance Capability
  - 2. Preliminary Training Plans
- C. System Standards
- D. Human Performance Requirements

Stage II. Training Objectives, Methods, and Materials
- A. Objectives
  - 1. Unique
  - 2. Common
  - 3. Higher Proficiency
  - 4. Transitional
- B. Methods and Materials
  - 1. Available Equipment
    - a. Electric Computer
    - b. Missile Firing
  - 2. Simulated Equipment
  - 3. Pilot Equipment

Stage III. Program Planning and Evaluation
- A. Service Test Training Evaluation
- B. Standardized Test Courses
- C. Test Support Requirements

Slides 7, 8, 9 & 10

Development Test, the Army Engineering Test, and the comparative tests across vehicles. It was also one of the major sources of information for the Training Device Concept Study that was conducted by Link Group under contract with the Naval Training Devices Center.

The crew tasks specified in these booklets were then ordered, on the basis of the mission narrative and definition, to form functional procedures for crew operation and maintenance of the MBT; they are being similarly organized for the other vehicles (Hand-Out 3: Functional Procedures—one report). For each of these crew functions we are obtaining the required system standards in terms of performance times, accuracies, and reliabilities; the system variables in terms of tactical and environmental conditions that will effect the standard; the tools that are required to accomplish the function; and any other information pertinent to the function. This information is further broken down by task so that we can determine the point in the flow diagram where human operator problems may occur, that is, where a training problem is likely

to exist. For each function we can then determine the human performance standard that is required to meet the system standard.

While these booklets are far from complete they are being used to determine the content of USAMC tests with regard to the areas for which system standards are not now available and must be determined. They are also being used locally for planning preliminary training and for the USCDC TATAWS studies.

The human performance requirements that we have determined on the basis of early mission and equipment analyses have thus been already utilized in a number of tactical, hardware, and human considerations. They have been obtained with little, if any, interference with equipment development, but they have provided a considerable amount of information that has been used to guide that development. As only one example, they showed that the proposed boresight procedures were both unrealistic and unfeasible. As a result the developer has changed both equipment and procedures before the Engineering Tests. In this regard we will agree that most design engineers do consider the human requirements as he designs the hardware. However, if these requirements are not provided specifically to him, he has little to base that consideration on.

In addition, this work has revealed a number of trainability items that must be considered during equipment development. While determining the requirements for nomenclature, location, and function training across the M60, E2, 551, and 70 vehicles, we found a complete lack of consistency in all areas. Technical manuals use different terms to designate the same piece of equipment placed in different vehicles. Panels having the same function are completely different in the different vehicles, with a different set of dials and knobs for each panel. For example, a very similar grenade launcher on the E2, 551, and 70 has three completely different operating panels. Obviously, this kind of needless inconsistency in both literature and hardware greatly increases the demands on the training establishments.

We think that, up to this point, the approach has worked fairly well. There have been problems and there are areas that require much more methodological research. However, this approach has provided the empirical data we need for the training analyses.

From this material we will be able to write the final training objectives for the functions that appear to be unique to the MBT. We are now studying the material for three other types of objectives: (a) those common to all or at least several vehicles, and for which common training could be provided (such as communication procedures or guidance and control equipment tests); (b) those involving common content but differing in the levels of proficiency needed (such as tracking moving targets for conventional or missile firing); (c) those with only transitional changes (such as tracking with different types of controls or different sighting systems).

For the common and transitional objectives, studies of training methods, time, and materials can be completed with available equipment. We have already completed a few such studies: one for computer

training and several for missile firing training (Hand-Out 4: Computer, Classified, Conduct of Fire—three reports). For unique objectives we will have to work with simulated equipment and conditions or wait for the pilot vehicles. We are now constructing apparatus to simulate training in discriminating the multiple returns from the laser rangefinder stadia and are coordinating with TECOM to obtain other data during the initial pilot tests.

For the final stage of our work we have, as I said previously, outlined the plan for the Service Test training evaluations. We are now working with USAMC in constructing test courses at Fort Knox that will be used for these tests and that will provide data comparable to that obtained during Engineering Tests. We are also working with the School and Center in planning for the support requirements for these tests.

In summary, I would like to stress that we consider this project to be more than routine training engineering. It is the first application of a complete human factors approach to any Army system. As such it is providing guidelines for a requirement that is becoming formalized within the R&D cycle. The approach is a partial basis for several new Army regulations and the task descriptions are being used by USAMC as an example for other developments, such as the MICV-70 and the ARSV. Beyond this, however, it is also demonstrating to us those areas in the cycle where our ability in application may be much less than our glibness in expostulation. As such, it is designating the areas where future research will be most fruitful.

Hand-Out 1: Preliminary Crew and Maintenance

Interim Report	Preliminary Outline of Gunner Duties and Tasks for US/FRG MBT-70, May 1967.
Interim Report	Preliminary Outline of Driver Duties and Tasks for US/FRG MBT-70, May 1967.
Interim Report	Preliminary Outline of Tank Commander Duties and Tasks for US/FRG MBT-70, May 1967 (For Official Use Only).
Interim Report	Preliminary Outline of Organizational Maintenance Duties and Tasks for US/FRG MBT-70 (Section I, Automotive Maintenance), January 1968.
Interim Report	Preliminary Outline of Organizational Maintenance Duties and Tasks for US/FRG MBT-70 (Section II, Turret Maintenance), January 1968.

Hand-Out 2: M60A1E1/E2 and M551

Research By-Product	Preliminary Outline of Crew Duties and Tasks for Operation of the M60A1E1/E2, February 1968.
Research By-Product	Crew Duties and Tasks for Operation of the M551, March 1968.
Research By-Product	Crew Duties and Tasks for Maintenance of the M551, July 1968.

Hand-Out 3: Functional Procedures

Research By-Product	US/FRG MBT-70 Crew Functional Procedures and Performance Standards, January 1968.

Hand-Out 4: Computer, Classified, Conduct of Fire

Consulting Report	A Comparison of Armor Trainees' Performances on the M13A2 and XM19 Ballistic Computers, November 1967.
Technical Report 67-6	Shillelagh Guidance Requirements and Gunner Tracking Proficiency (U), June 1967 (CONFIDENTIAL).
Interim Report	Training Effectiveness of XM35 Conduct of Fire Trainer (COFT), March 1967.

Work Unit CAMBCOM
Knowledges, Skills, and Thought Processes of the Battalion Commander and Primary Staff

Mr. Theodore R. Powers
Senior Scientist, HumRRO Division No. 4 (Infantry)

The objective of Work Unit CAMBCOM (Combat Arms Maneuver Battalions Command) is to identify the knowledges, skills, and thought processes of the battalion commander and his principal staff officers. This research was accomplished as part of an Exploratory Study and thus we do not as yet have any definitive results to report. However, it is hoped that this briefing will give you an idea of some of the procedures that are called upon when job and task analysis are used as a systematic basis for deriving training content.

This research was requested by the U.S. Army Infantry School (USAIS) and USCONARC is the military sponsor of the study.

The USAIS is responsible for presenting many programs of instruction, including both officer Basic and Advanced courses. As an important part of its self-improvement program, the USAIS continually stresses the review of its teaching methods and content, both for these and other curricula. With the rapid advance of educational technology in recent years, the USAIS has realized that for efficient utilization of new knowledge, future review and planning should be enlarged to include all aspects of the school situation.

As a result of this philosophy, a USAIS Master Plan was developed that encompasses the time frame of 1967 to 1975. The primary objective of the Master Plan is the improvement of instructional content and procedures by the adoption of innovations in training technology. The Plan emphasizes that such an approach requires a systematic derivation of training content as a critical first step in the revision of a curriculum. This approach is consistent with HumRRO's concept of training technology.

As part of the implementation of the Master Plan, the USAIS has shown particular interest in validating both the content and specific learning objectives for their programs of instruction. For example, several years ago Work Unit LEAD initiated inputs into training programs designed for the junior officer.

To offer guidance for the programs designed for the more senior officer, the USAIS included in the FY 1968 Dragnet Survey[1] a proposal that HumRRO undertake research aimed at identification of the knowledges,

[1]The Request for Human Factors Research Requirements by the Chief of Research and Development.

skills, and thought processes of the battalion commander and his principal staff officers. The USAIS will use the information developed by this research (Slide 1) to (a) validate that portion of the Infantry Officer Advanced Course (2-7-C22) that is concerned with battalion commander and staff procedures, (b) develop a basis for the derivation of training objectives (Student Performance Objectives) as prescribed by USCONARC Regulation 350-100-1 and USCONARC Pamphlet 350-14, and (c) revise USAIS doctrinal literature as appropriate.

With the receipt of the research requirement, coordination meetings were held with USAIS personnel and the following guidelines were established (Slide 2): (a) The research will focus on those battalions classed as combat maneuver battalions (Infantry, Light Infantry, Mechanized Infantry, Airborne Infantry, Airborne Infantry Airmobile, Armor); (b) the research will encompass the identification of the knowledges, skills, and thought processes of the primary battalion staff (S1, S2, S3, S4) and the battalion commander; and (c) for research purposes, the staff will be considered to be as specified in a TO&E with all officers holding the authorized grade for their position.

During the initial stages of the Exploratory Study, a judgment was made that, due to the qualitative differences between the concepts of thought processes and the relatively more tangible factors of knowledges and skills, there would eventually evolve two somewhat different methods of gathering information for these areas. This assumption has proved to be correct and in this presentation the methods of gathering data for these two factors are presented and discussed separately.

One major objective of the Exploratory Study was to find the job analysis method that had the greatest potential for systematic collection, quantification, and organization of information about the job requirements of the battalion commander and his staff. An off-the-shelf method of analysis was sought since the projected time frame of the Exploratory Study and resultant Work Unit would not permit the development and testing of a new procedure.

A literature survey revealed the basic types of information-gathering methods that had previously been used to identify knowledge and skill requirements. To judge the appropriateness of these various methods, the following criteria were developed (Slide 3), which reflected the resources that would be available to the Work Unit: (a) Direct observation of the job incumbent would not be a critical requirement of the procedure, (b) procedure could be efficiently applied in a man-oriented system, (c) procedure could be concurrently applied to several different types of jobs, (d) procedure would not only identify types of job information but would also make hierarchal judgments as to their importance, and (e) the time required for the procedure would easily fit within the time frame of the Work Unit.

These criteria were applied to various job analysis procedures and it was judged that the method currently used by the U.S. Air Force (USAF) could be modified to meet our research requirements.

Objectives

1. Validate procedures.
2. Basis for training objectives (CON Reg. 350-100-1, CON Pam. 350-14).
3. Basis for doctrinal revision.

Slide 1

Guidelines

1. Combat maneuver battalions.
2. Battalion CO and S1, S2, S3, S4.
3. TO&E staff.

Slide 2

Criteria

1. Observation not required.
2. Man-oriented system.
3. Different jobs.
4. Importance judgments.
5. Acceptable time frame.

Slide 3

Besides meeting the criteria previously mentioned, the USAF method offered the advantages of (a) having been originally developed to identify tasks in a military environment, (b) having established administrative procedures that had been successfully applied in a military environment, and (c) having support and technical requirements that were within the capability of the HumRRO research staff.

The procedure that we are using to identify knowledge and skill requirements will consist of the following steps (Slide 4):

Step 1: A preliminary task inventory will be developed by utilizing expert opinion, job standards, doctrine, and existing job descriptions. As a starting point, a draft inventory will be devised using written sources of information and it will then be submitted to technical experts for informal comment. All sources of information used in this step are available at the USAIS, the USAIHRU, and HumRRO Division No. 4 (Infantry).

Step 2: The preliminary task inventory will be sent to the field for comment by job incumbents and other experts. The principal objective of this step is to gather recommendations as to the addition or deletion of knowledges and skills to the preliminary task inventory. The plan is to have a staff of each type of maneuver battalion surveyed during this step.

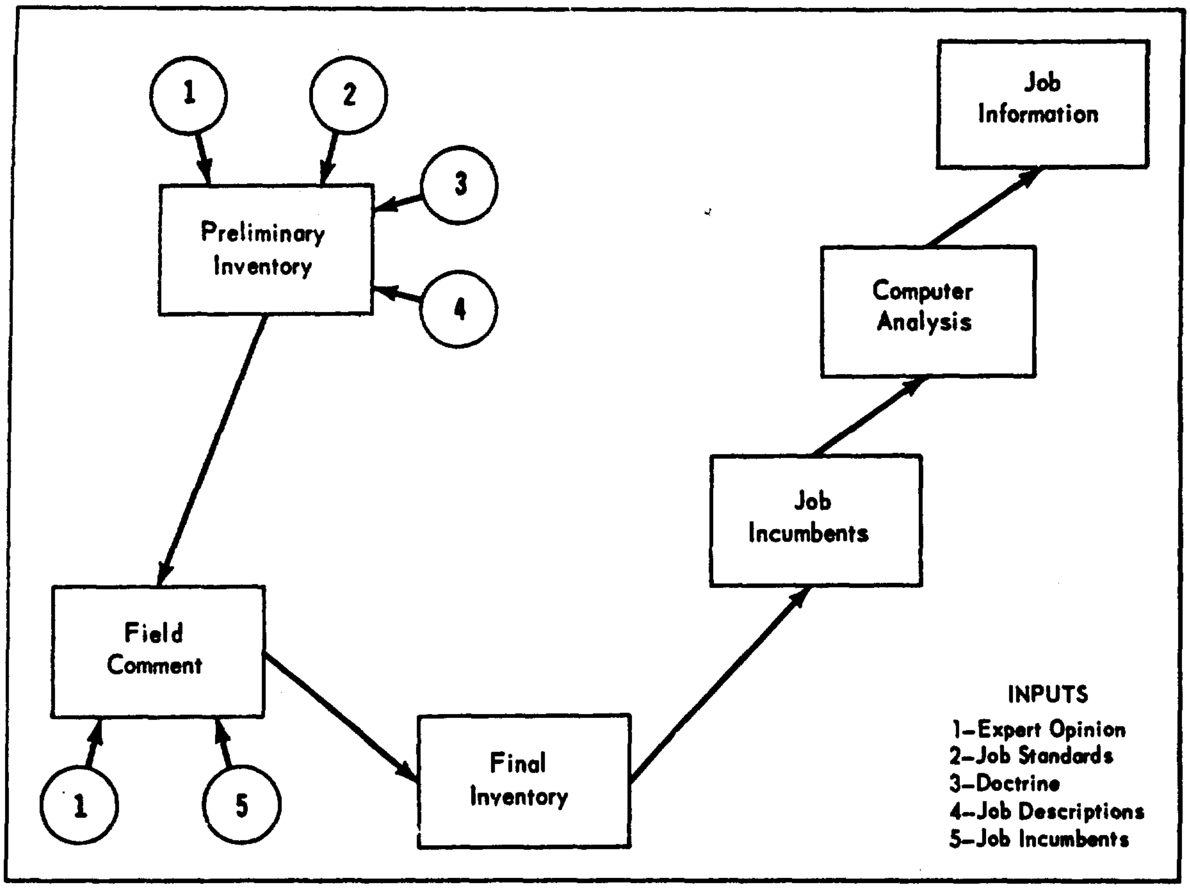
Step 3: The final inventory will be developed by assessing the field comments on the preliminary inventory. A major judgment here will be whether the field comments reflect local job variation rather than basic knowledge and skill requirements that should be taught at a school.

Step 4: The final inventory will be submitted to job incumbents for comment. The basic information sought will consist of which knowledges and skills on the list are being performed, how often they are performed, how much time is required to complete them, and how important they are to mission accomplishment. Currently, there are about 212 maneuver battalions in the Army; our plan is to contact at least 100 of them and ask them to participate in the research. The USAF method of contact involves a mailed questionnaire supported by command emphasis and this procedure will also be used in the present research.

Step 5: When completed and returned to the research staff, the data will be subjected to computer analysis. This analysis will develop the job information.

It is anticipated that a ranked list of knowledges and skills will be generated such as the example from a job description shown in Slide 5. The USAIS has indicated that with information of this type, valid additions and deletions can be made to the Advanced Course subject matter, a basis for the establishment of training objectives can be derived, and doctrinal revision can be instituted where appropriate.

Although a large number of methods and procedures have been developed to gather information about knowledges and skills, the area of thinking has not lent itself to such systematic exploration.



Slide 4

Example of Job Description: Medical Laboratory Specialist

Importance	Knowledge and Skill	% Perform	% Time	Cumulative Time	Mission Accomplishment
1.	Collect blood specimens	91	2	2	1
2.	Perform blood count	86	2	4	1
3.	Perform cell count	86	2	6	1
4.	Prepare specimens	85	1	7	1
22.	Prepare culture media	75	1	25	2
29.	Crossmatch blood	70	1	31	3
185.	Use autotechnicon	9	1	93	8

Slide 5

There have been a few noteworthy efforts to categorize thinking and to conduct research on mental processes. Although much of this work has been successful from the experimenter's viewpoint, the results have been exceedingly difficult to generalize to other than the experimentally studied behavior. Part of this difficulty stems from much of the previous research being concentrated on the study of thought processes in artificial laboratory situations especially created so that the researcher could apply acceptable experimental control.

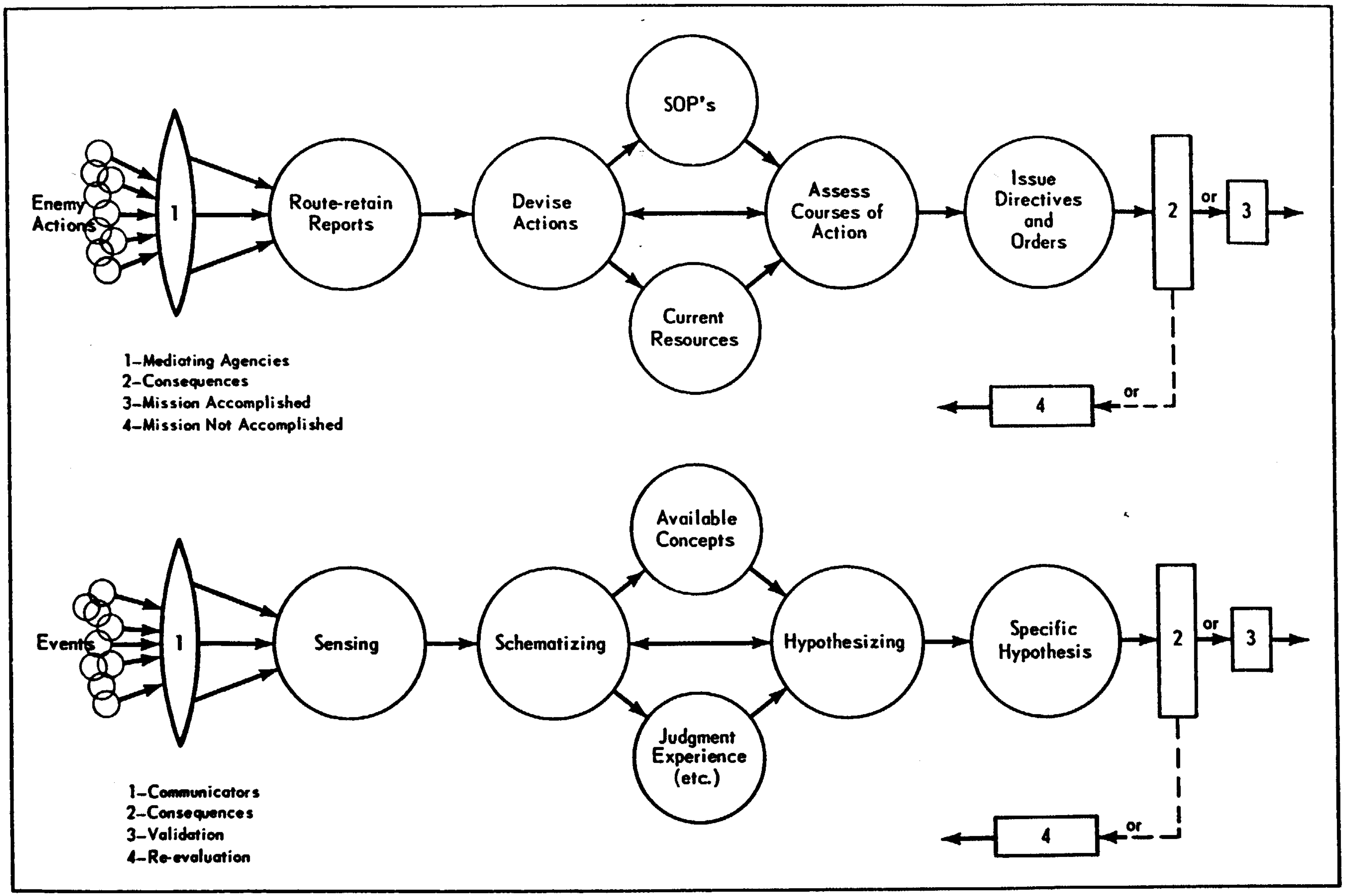
Discussions with the USAIS have indicated that their interest in the thought process area is not primarily in identifying the basic attributes of thinking, but rather in knowing more about how mental processes operate within the framework of the battalion staff. With this guidance, some of the possible environments in which information of this type might be collected were examined. It was found that Work Unit FORGE of HumRRO Division No. 4 faced similar questions.

FORGE has the mission of identifying and obtaining better understanding of the human factors that influence performance of command and control functions in military organizations. To attack this problem, FORGE researchers have chosen simulated battalion command post exercises as their primary data-gathering vehicle. The CPXs seemed also to meet the needs of CAMBCOM in that (a) a functioning battalion staff system would be operating, (b) rigid experimental controls could be applied, and (c) inputs to the system could be carefully controlled and thus any reactions to the various inputs could be identified and studied.

The research data from the CPXs will consist of several elements. These will include controlled inputs into the battalion system, monitoring of all operations and communications to include the tape recording of all conversations, and visual observation of staff procedures.

The analysis of the CPX data will be conducted by CAMBCOM in the following manner (Slide 6): First, an input will be identified and the impacts it makes as it travels through the staff system will be studied. Of particular interest will be the processes generated within and between the staff positions. These processes may be similar to the ones shown in Slide 6 where the top line indicates an evolving military situation and the bottom line indicates some mental processes that are possibly concurrently occurring in a situation of this type. Please note that the slide depicts only a generalized concept. It is hoped that the research will identify more detailed thought sequences.

The USAIS has indicated that the identification of such sequences would supply them with many valuable insights and much valuable information about the mental processes of the battalion commander and staff. This information will also be implemented into the Advanced Course where possible, although it is realized that concepts such as these do not as readily lend themselves to incorporation in a curriculum as do the relatively more tangible factors of knowledges and skills.


Enemy Actions
1
Route-retain Reports
Devise Actions
SOP's
Current Resources
Assess Courses of Action
Issue Directives and Orders
2
or
3
or
4
1–Mediating Agencies
2–Consequences
3–Mission Accomplished
4–Mission Not Accomplished
Events
1
Sensing
Schematizing
Available Concepts
Judgment Experience (etc.)
Hypothesizing
Specific Hypothesis
2
or
3
or
4
1–Communicators
2–Consequences
3–Validation
4–Re-evaluation

Slide 6

Work Unit UPGRADE
Improving Aviation Maintenance Training Through Task and Instructional Analysis

Dr. Wallace W. Prophet
Director of Research, HumRRO Division No. 6 (Aviation)

My presentation today concerns our research on aviation maintenance training carried out under Work Unit UPGRADE. This Work Unit is sponsored by USCONARC and was initiated in response to a request from the U.S. Army Aviation School for research aimed at increasing the job relevance of aviation training curricula. Our efforts have also been coordinated with the U.S. Army Transportation School at Fort Eustis.

Our activity in Work Unit UPGRADE has two aspects. One involves an application of job analysis to a specific aircraft maintenance MOS and is aimed at producing immediately usable job data for the Transportation and Aviation Schools. The other, more generalized aspect of the research is a comparative study of several techniques for gathering and using job descriptive data. It is this latter area, the development of generalizable techniques for acquiring and using job descriptive data, which I wish to emphasize today.

Development of programs of instruction having maximum job relevance requires an extensive and detailed knowledge of job requirements. Most systematic approaches to training development—USCONARC Regulation 350-100-1, HumRRO's Seven Steps, or whatever technique—emphasize the importance of acquiring information from the field—from the job itself—as the basis on which curricula are developed and revised.

As we studied the problem of making Army aviation maintenance training more job relevant, our first choice as to a technique for acquiring job data from the field was the use of teams of skilled observers to gather detailed task performance data on site. While this approach undoubtedly produces the best data, we quickly rejected it as too expensive and infeasible for general Army use. We then turned to several variations of the survey technique using detailed job description inventories, or JDI as I shall refer to them in the remainder of my remarks. The field survey technique is feasible for routine Army use and, of course, forms the basis for the Military Occupational Information Data Bank effort of the Office of Personnel Operations, Department of the Army.

The questions concerning field survey techniques using JDI to which we are seeking answers in UPGRADE can be described as follows (Slide 1): (a) What is the relative information yield of administration to job incumbents by mail, administration to job incumbents on

site by a survey team, and administration to field returnees by a survey team; (b) how much and what level of detail in job descriptive data are required for effective systems engineering of training; and (c) what are the characteristics of the sampling necessary to get accurate representation of job dimensions and requirements?

UPGRADE Questions

I. Information yield
   A. job incumbents by mail
   B. job incumbents by survey team
   C. field returnees by survey team

II. Amount and level of detail required

III. Sampling characteristics

Slide 1

In addition, another important area of concern in UPGRADE is techniques for utilizing job data and the preparation of "how-to-do-it" procedural manuals covering the details of JDI development and use.

When detailed job descriptive data are acquired from a sizable number of respondents, the training manager of curriculum engineer may have a sizable data reduction and handling task. Further, there are problems relating to standardization of the manner in which responsibility for the training of specific tasks is allocated to the central schools and to units. Therefore, in UPGRADE we are devoting attention to the development of computer techniques for handling the task data produced by the JDI (or by other methods) and the development of a mathematical model of the training allocation decision process. The computer model will not make the final decision for the training manager, but it will provide him with a valuable tool which will relieve him of much routine task data handling. It will give the manager a systematic and standardized means for defining which tasks will be trained at the schools and the level to which they will be trained. Thus, the decision model can be applied uniformly in different courses and locations.

UPGRADE is being conducted under two Sub-Units. The first is concerned with development of techniques for acquiring and utilizing aviation maintenance job description data; the second concerns the development of a unit training package for the UH-1 helicopter mechanic, MOS 67N20.

My discussion today centers on UPGRADE I. Specifically, I will discuss the composition of the job description inventories developed for the 67N20 mechanics and their enlisted supervisors, the sample of survey respondents, and some discussion of a preliminary analysis of written survey comments.

UH-1 Mechanics Task List

Tasks		(A)	(B)	(C)				
		CHECK ✓	CHECK ✓	CHECK ✓				
		if neither performed nor assisted	if only assisted	if performed				
INTERIOR LIGHTS (Any One)								
1. Obtain serviceable replacement	1.							
2. Remove	2.							
NAVIGATION LIGHTS (Any One)								
1. Repair	1.							
2. Troubleshoot	2.							
3. Install	3.							
NAVIGATION LIGHT FLASHER								
1. Obtain serviceable replacement	1.							
2. Troubleshoot	2.							
3. Install	3.							

Slide 2

UH-1 Mechanics Task List

Tasks		(A)	(B)	(C)	ONLY FOR TASKS THAT HAVE BEEN PERFORMED			
					(D)	(E)	(F)	(G)
		CHECK ✓	CHECK ✓	CHECK ✓	# TIMES PERFORMED PAST MONTH	# TIMES PERFORMED DURING PAST YEAR	FIRST PERFORMANCE AFTER AWARD OF 67N20 DUTY MOS	YOUR PROFICIENCY IN PERFORMING TASK
		if neither performed nor assisted	if only assisted	if performed	enter number	enter number	1-1st month 2-2d or 3d month 3-4th to 6th month 4-7th to 12th month 5-After 12 months	1-Poor 2-Fair 3-Good 4-Very Good 5-Excellent
INTERIOR LIGHTS (Any One)								
1. Obtain serviceable replacement	1.							
2. Remove	2.							
NAVIGATION LIGHTS (Any One)								
1. Repair	1.							
2. Troubleshoot	2.							
3. Install	3.							
NAVIGATION LIGHT FLASHER								
1. Obtain serviceable replacement	1.							
2. Troubleshoot	2.							
3. Install	3.							

Slide 3

The job description inventory which we have been administering consists of four general sections. The first section is concerned with the man's background and training. Section II is concerned with maintenance duties and working conditions in the man's present unit. The third section, which is the real heart of the questionnaire, is the detailed UH-1 maintenance task inventory. Section IV asks for information on equipment, general maintenance, and non-maintenance duties. In all, the JDI takes two to four hours to complete, largely as a function of the man's speed of reading.

A total of 1,294 UH-1 maintenance tasks are covered in Section III of the inventory. Due to the large number of tasks involved, we prepared two different forms of the questionnaire for the mechanics, each containing only half of the 1,294 tasks. The enlisted supervisors completed the information for all 1,294 tasks.

Slide 2 shows a portion of Section III of the JDI. On the left are shown some of the specific maintenance tasks. For each of these tasks the mechanic is asked to indicate if he has neither performed nor assisted with the task, if he has only assisted, or if he has had the major responsibility for performing the task.

For each task he checks in Column C as performed, he is asked to give the number of times he has performed the task during the past year, the amount of time to his first performance of task after his award of the 67N20 duty MOS, and an indication of his proficiency in performing the task (Slide 3).

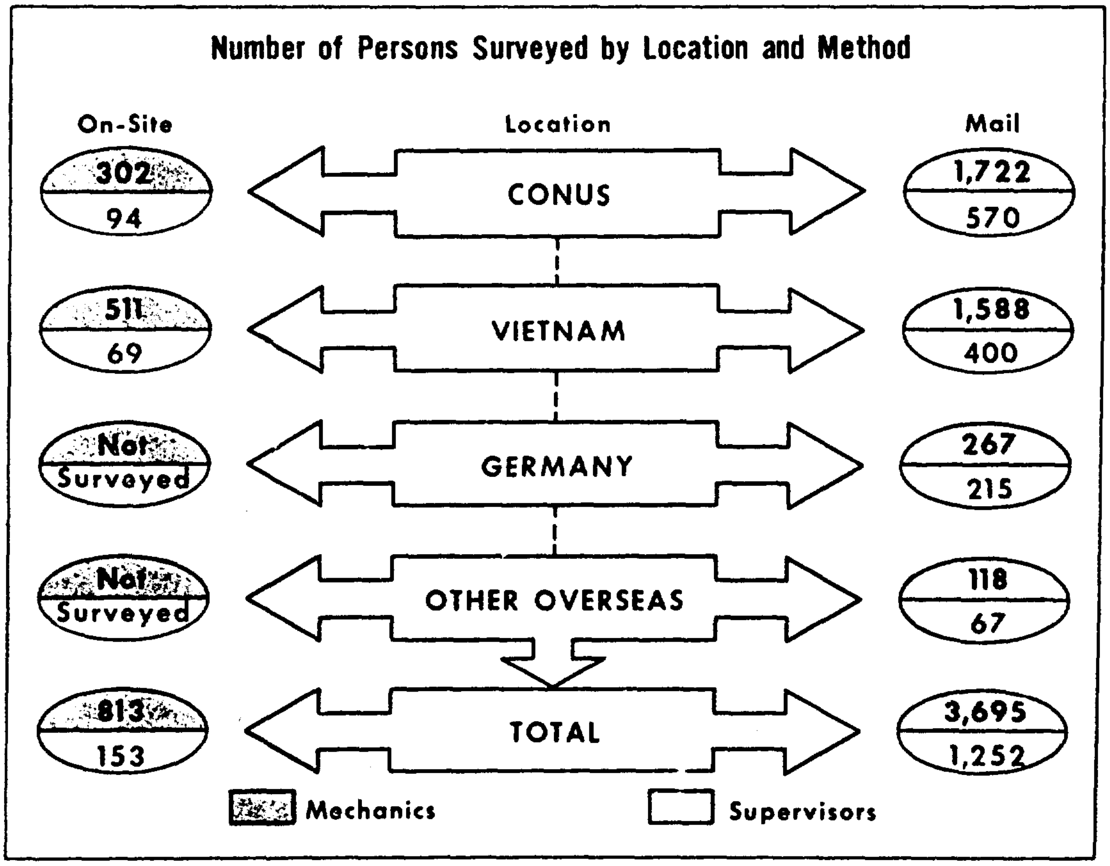
Responses to these items will provide the basic data for defining the 67N20's job as it exists in the field. They will allow us to determine frequency of task occurrence for different types of units, locations, and situations and how soon after graduation the man performs each task. Obviously, training should prepare the man to perform those tasks which occur frequently. On the other hand, if a task typically doesn't occur until the man has been out of school for 10 months, perhaps it shouldn't be covered in school training—the man will forget what he has learned before he has a requirement to use it. However, if such a task must be taught in school because it is impractical to teach it in the unit, or because of other reasons, we may have to build "over-learning" into the school POI so that the man will not forget the task.

While the supervisors were required to respond to all 1,294 tasks, they were asked only two questions for each task (Slide 4). First, they were asked to indicate the amount of direction that was required by the typical new 67N20 graduate in performing each task. Next, they were asked to indicate those tasks which they felt the new 67N20 graduate must be able to perform with little or no direction immediately after arrival in the unit. These items give us the supervisor's assessment of what the new school graduate can and cannot do when he reports to the field, and which tasks are of major or critical importance in unit operations. Information on task criticality, along with that on such factors as task frequency and time to first performance will be represented in the task training allocation math model.

UH-1 Mechanic Supervisors' Task List

Tasks	COLUMN A	COLUMN B
	AMOUNT OF DIRECTION REQUIRED BY NEW 67N20	TASKS NEW 67N20 IN YOUR UNIT MUST BE ABLE TO PERFORM IMMEDIATELY WITH LITTLE OR NO DIRECTION
	0 Not observed or task not performed 1 Constant direction 2 Much direction 3 Some direction 4 Little direction 5 No direction	CHECK ✓
INTERIOR LIGHTS (Any One)		
1. Repair	1.	
2. Obtain serviceable replacement	2.	
3. Troubleshoot	3.	
4. Remove	4.	
5. Install	5.	

Slide 4



Slide 5

Emphasis in the supervisor's questionnaire has been placed on the new graduate. This contrasts somewhat with the MOI Data Bank approach which does not intentionally include job incumbents with less than six months of on-job experience in their survey sample. In addition, they do not query the supervisor about the performance of his subordinates. We feel that, from a training standpoint, the job picture of the relatively new mechanic—that is, a man with less than six months' experience—is necessary to provide a guide for school training. We also feel that the enlisted supervisor can play an important role in providing information for the improvement of training curricula.

In addition to the JDI administered to mechanics and enlisted supervisors, a much shorter questionnaire form was administered to maintenance officers. Their responses provide a broad overview of UH-1 aviation maintenance.

In September of 1967 there were 11, 655 67N20s in the Army, and 4,462 persons carrying the supervisory MOSs. Approximately one-half of the 67N20s and two-thirds of the supervisors could not be considered for survey, principally because they were in-transit or out-transit or had an ETS[1] date or DEROS[2] before the dates of the survey. Our total worldwide sampling consisted of almost 5,000 67N20s and 1,500 supervisors, or practically 100% of the persons available for survey. In addition, we have contacted about 400 maintenance officers. All together, over 400 aviation units are represented.

Slide 5 shows the numbers of mechanics and supervisors surveyed by the on-site and mail methods for each of the four survey locations. For example, on-site we surveyed 302 mechanics and 94 supervisors in CONUS; in Vietnam we contacted 511 mechanics and 69 supervisors. Germany and Other Overseas areas were not surveyed on-site. The numbers for the mail survey are shown on the right side of the slide. At the bottom are shown the totals for all areas; 813 mechanics and 153 supervisors on-site, and 3,695 mechanics and 1,252 supervisors by mail.

This large sample was needed to provide adequate representation of unit types for each method of administration and each geographical area.

In addition to the respondent groups just shown, we have surveyed a group of 132 recent field returnees at Hunter Army Airfield and Fort Stewart, Georgia. They provide our third major respondent group.

We completed the gathering of our Vietnam data just last month. As you can appreciate, the task of handling these large amounts of data is a formidable one. Consequently, the data are being prepared for computer processing. The computer analysis is scheduled for the 3rd and 4th quarters of FY 1969.

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[1]Expiration term of service.
[2]Date eligible for return from overseas.

We have also extracted the written comments from the several thousand questionnaires we have received, and have categorized and tabulated them. These comments run the expected gamut from the usual soldier "gripes" to rather thoughtful analysis of training and operational problems. One individual even provided us with a very well-conceived POI for maintenance training which ran to several pages. Generally, the comments were quite constructive and thoughtful in tone. In fact, we were pleasantly surprised at the extent to which these respondents went out of their way to amplify or explain certain of their answers.

The comments cited such things as malassignment and strengths and weaknesses of school and unit training. Since most of the topics mentioned are covered by the questionnaire, I will not describe any of the comment data. However, many of the comments give excellent anecdotal illustration of some of our problems in aviation maintenance and training.

My statements today are intended only to give you some idea of the nature of our data, not to present findings. The areas of comment I have touched on are covered in depth in the questionnaire and, of course, will be analyzed much more extensively and systematically in our computer data.

In summary, when the UPGRADE data are completely analyzed we hope not only to have developed an accurate picture of the 67N20 job as it exists in the field, but further we hope we will have provided techniques for gathering job description information which will detail for aviation maintenance some of the procedures outline in USCONARC Regulation 350-100-1.

Training Implications and Discussion

Mr. Harold A. Schulz
Educational Advisor, Headquarters, USCONARC

It is my purpose to analyze the general issues raised by the four reports presented and to identify implications they may have for us.

While the reports were related to the use of the job or task analyses in on-going research, each presented a different aspect of the procedure. (From this point on I shall refer to task and skill analyses as QQPRI or TASA, which is the nomenclature in the regulations). Dr. McKnight stressed the need for continuing dynamic involvement of TASA to assure full utilization in the training process. Dr. Haggard's application of TASA was related to new equipment. He established the need for involvement in the earliest phases of weapon system development. Dr. Prophet's report discussed a comparative evaluation of several techniques for TASA data collection. His findings will be used as a basis for the development of techniques which can be generalized. Mr. Powers' study is related to higher level positions and includes the unique area of analysis of the thought processes involved in job performance. Three major points can be synthesized from the papers presented.

First and foremost is the need to apply the analytic approach or TASA to determine job-based training requirements. The requirement for this foundation from which to operate extends to training research projects, new course development, and existing course revision. The need for TASA has long been recognized by training elements in the Army. The first TASA was prepared for an Army-developed weapon system in 1958, the next in 1959 for another Army weapon system. These were initiated early in the development cycle but required "selling" to the Weapon System Manager as a training element requirement. Between 1960 and today, TASA was produced if someone in the System Manager's office convinced him that it was necessary. Today we have AR 611-1 which directs that TASA or similar data be provided. In addition, AR 750-5 provides a format for TASA which is identified as DATA Item 14-002 for new equipment systems, while USCONARC Regulation 350-100-1 requires a job analysis as the first step in course design. From this it is apparent that the need for TASA has been established in the Army training element; however, it must be recognized that, for new equipment, TASA or its equivalent is a USAMC product.

The second subject raised by the reports that warrants further consideration is the variation in preparation, content, and use of a QQPRI or a TASA. The variation is apparent in the papers presented just as it is in normal Army application. HumRRO Technical Report 83

on the prediction of training requirements for future weapon systems[1] thoroughly explores a wide range of problems related to TASA and presents a rather detailed specification for one. AR 750-5 on the other hand, provides guidance on content and format of a TASA. The documents contain the best thinking at the time they were prepared. Unfortunately they do not reflect current experience and exploration such as we have heard presented this morning, nor do they provide sufficient guidance today to prepare a TASA or QQPRI. The use of computers, dynamic involvement, or the application of analyses to "software" job requirements and the thought process were not anticipated. In addition, a generalized procedure for TASA development flexible enough to accommodate the full range of Army jobs is needed. To illustrate: both QQPRI and TASA are to be provided by the Weapon System Manager. However, USCONARC prepared the QQPRI for a major system in the past year, and as recently as last month we were queried by the Weapon System Manager on what the specifications for a TASA should contain. Thus it is evident that an expansion and updating is in order to clearly define what is required.

Before going on it is necessary to quantify in terms of dollars what cost the development of human factors data of the order and quality Dr. Haggard's group prepared would add to a complex, major weapon system's cost. The most recent estimate I have heard indicates it would exceed three million.

The third area of consideration raises questions about the management process for development of Army systems and human factor involvement. Providing for participation of training and personnel elements early in the life cycle of a new system has been recognized for a number of years. It became a pressing issue when the first Army TASA was developed in 1958. It is significant to note that all three services experience similar problems when new weapon systems are fielded. It must be recognized that the Army weapon system life cycle management process which is now evolving is a major improvement. The attitude of those involved is strongly positive and receptive. Unfortunately the current system has two defects. It does not provide for a personnel subsystem or training involvement in the Concept Formulation Phase. Restricting training involvement until later in the program has proven unsatisfactory since the key decisions have been made by the time we participate and the irretrievable lead time needed for orderly process is lost. Dr. Haggard has presented examples from the automotive field. The Sentinel systems present equally illustrative cases.

Three studies have been conducted for the Army in this area. The first study was prepared by the American Institutes for Research in 1959. It is titled "Suggested Procedures for Integrating Training Decisions into Missile Systems Development." The report is in reality a summary of the findings of an Army project group. The second study

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[1]J.C. Rupe, *The Prediction of Training Requirements for Future Weapon Systems: A Personnel Support System Research and Development Process*, HumRRO Technical Report 83, April 1963.

is reported in HumRRO Technical Report 83 on prediction of training requirements for future weapon systems. The third and most comprehensive study is entitled "Systems/Project Management, Procedures for Integrated Management of the Human Factors (Personnel-Related) Aspects of Army Systems Development," dated July 1966. These studies can serve as points of departure for the development of an Army personnel subsystem.

In conclusion, the need for QQPRI and TASA is recognized as the foundation on which to base training. It is also apparent that the content and dimensions of these documents must be more adequately described. Finally, a personnel subsystem must be established and utilized throughout the life cycle of a system. Continuing active interest of this headquarters is clearly required to ensure that the documentation of such system provides for training participation as part of the personnel subsystem in the total life cycle management process and the preparation of human factors data such as QQPRI in the form required.

Closing Remarks

Major General O'Connor

I would like to take this opportunity to thank Dr. Crawford and members of his staff for presenting an informative and interesting briefing on job and task analysis. I would also like to extend my thanks to Mr. Schulz, the DCSIT Education Advisor, for his comments.

Exchange of training research information through periodic presentations similar to that which we have heard this morning provides USCONARC with a rare opportunity to keep abreast of and gain insight into the complexity of the Army training system.

One important fact that should be emphasized is that these training research programs are designed to be responsive to Army-wide training requirements. We, therefore, depend upon you, members of the USCONARC staff, to keep these on-going programs in consonance with your training problems and requirements.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* Human Resources Research Office The George Washington University Alexandria, Virginia 22314	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

USE OF JOB AND TASK ANALYSIS IN TRAINING

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Professional Paper

5. AUTHOR(S) *(First name, middle initial, last name)*

HumRRO Staff Members

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
January 1969	42	0

8a. CONTRACT OR GRANT NO. DA 44-188-ARO-2 b. PROJECT NO. 2J024701A712 01 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) Professional Paper 1-69 9b. OTHER REPORT NO.(S) *(Any other numbers that may be assigned this report)*

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES Papers for USCONARC Briefing on Training Research and Development Programs	12. SPONSORING MILITARY ACTIVITY Office, Chief of Research and Development Department of the Army Washington, D.C. 20310

13. ABSTRACT

This paper records the four presentations on the "Use of Job and Task Analysis in Training" made by members of the HumRRO staff at a briefing sponsored by the Office of the Deputy Chief of Staff for Individual Training at Headquarters, U.S. Continental Army Command in October 1968. The presentations specifically describe job and task analysis and its role in curriculum engineering. The briefing was designated the first of a series of briefings on training research and development programs of the U.S. Army Behavioral Science Research Laboratory, the Center for Research in Social Systems, and HumRRO.

Unclassified
Security Classification

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Job Description and Analysis						
Task Description and Analysis						
Training Concepts and Theories						
Training Research						

Unclassified

Security Classification